DEC STD 103-7 Electromagnetic Compatibility (EMC) - Quality Process

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ABSTRACT: This standard outlines a quality assurance process to be used by Digital to ensure the continued EMC quality of each product during its manufacturing lifetime. This standard describes the three parts of the Quality Assurance Process (QAP): the Quality Assurance Test Plan (QATP), the Critical Features List (CFL), and the Critical Features Control Process (CFCP).

APPLICABILITY: This standard is applicable to all hardware products manufactured by Digital.

STATUS: APPROVED 07-Dec-1990; use VTX SMC for current status.

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CONTENTS

1 INTRODUCTION 1
1.1 SCOPE 1
1.2 PURPOSE 1
1.3 RESPONSIBILITIES 1
1.4 IMPLEMENTATION 2

2 QUALITY ASSURANCE PROCESS (QAP) 2
2.1 QUALITY ASSURANCE TEST PLAN 2
2.1.1 EMC QA Production Test Sample Size 2
2.2 CRITICAL FEATURES LIST (CFL) 3
2.3 CRITICAL FEATURES CONTROL PROCESS 6

Appendix A REFERENCED DOCUMENTS 7

A.1 EL-Class Digital Documents 7

FIGURES

1 Sample Size for Products Without a CFL 4

TABLES

1 QA Production Test Sample Size for Each Plant 3
2 Examples of Critical Features 5

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1 INTRODUCTION

This document describes the Quality Assurance Process to be used by Digital to ensure the continued electromagnetic compatibility (EMC) quality of each product during the product's manufacturing lifetime. This standard describes the three parts of the Quality Assurance Process (QAP): the Quality Assurance Test Plan (QATP), the product's Critical Features List (CFL), and the Critical Features Control Process (CFCP).

1.1 SCOPE

This standard is mandatory for all products manufactured by Digital which have a primary power interface. Examples include terminals, printers, and CPUs. Examples do not include keyboards that are considered part of the system using the keyboard.

1.2 PURPOSE

The Quality Assurance Process ensures that all products manufactured by Digital meet or exceed all design requirements for electromagnetic compliance during the product's manufacturing lifetime.

1.3 RESPONSIBILITIES

Ultimate responsibility for the QAP resides with the Manufacturing Quality Engineer responsible for the product. However, a team effort is required by the responsible EMC Engineer, member(s) of the product design team, and member(s) of manufacturing and quality engineering associated with the product.

- The EMC Engineer shall provide guidance concerning components and processes that could affect EMC performance.
- The design team engineers shall provide guidance concerning product parameters that could be affected.
- The Manufacturing and Quality Engineers shall provide guidance concerning the manufacturing process used for a product.

Each manufacturing plant shall be considered a separate manufacturer for each product. For example, if a product is manufactured at more than one plant, each plant must create a separate QAP for that product *unless the manufacturing processes are identical*. The final testing of the quality of the product shall be the same for each plant manufacturing the product.

The EMC domain Engineer is responsible for resolving questions concerning the applicability of this standard to a product.

1.4 IMPLEMENTATION

The QAP is required by first revenue ship (FRS) for each product defined in subhead 1.1. All products that have FRS after 01-Apr-1991 must implement this standard by 01-Jul-1991.

NOTE

A new product is defined as any product that 1) has not been manufactured before, 2) has had a change in its marketing name, 3) has had a change in its enclosure, or 4) has been value engineered (that is, cost reduced).

2 QUALITY ASSURANCE PROCESS (QAP)

The QAP includes an appropriate QATP, a complete and accurate CFL, and an implemented CFCP. It can consist of only the QATP, but without a CFL and a CFCP, the sampling rate of the product must be significantly higher with associated higher testing costs. The CFL is an optional part of the QAP, but not having a CFL requires additional quality assurance (QA) testing.

2.1 QUALITY ASSURANCE TEST PLAN

The QATP is developed and used by the responsible manufacturing and EMC groups to perform EMC tests to demonstrate continued compliance to DEC STD 103-0 *Electromagnetic Compatibility (EMC) - Overview and Process Requirements* and the following sections of that standard.

The QATP includes the test configuration, sample test rate, responsible individuals, and test location. Any special testing procedures used to reduce the total amount of testing, testing costs, and logistics must be defined.

Manufacturing is responsible for implementing the QATP. This includes ensuring that material for the QATP is provided to the designated EMC test facility at the appropriate time. Manufacturing is also responsible for the cost of moving the material, and performing and documenting the tests.

When a failure occurs during the execution of the QATP, the resolution shall follow the recommendations in the individual QATP. The product's sustaining engineering group and EMC group shall work together to identify the problem(s) and recommended solution(s).

The sample rate for the QATP shall be determined by the EMC engineer and the manufacturing representative. Test sample sizes are listed in this standard as a guide for the EMC and Manufacturing Engineers to use in their decision to set the test sample rate.

2.1.1 EMC QA Production Test Sample Size

The number of units to be QA tested is based on the stability of the manufacturing process as well as the risk to the corporation. If field upgrades or fixes are required, the cost to the corporation could be significant.

The risk is based on the number of units likely to be effected, as well as the possibility that a change in the manufacturing process would not be detected within the typical QA procedures. To ensure that any changes in the manufacturing process are detected, the CFL is used to enhance the QA process. Products and processes with an implemented CFL

are more likely to have a stable manufacturing process, and therefore less of a variation among production units.

Therefore, the QA sample size depends on whether a CFL is implemented. The categories shown in Table 1 and Figure 1 give the recommended sample sizes for products both with and without implemented CFLs, as well as low-volume products.

Table 1: QA Production Test Sample Size for Each Plant

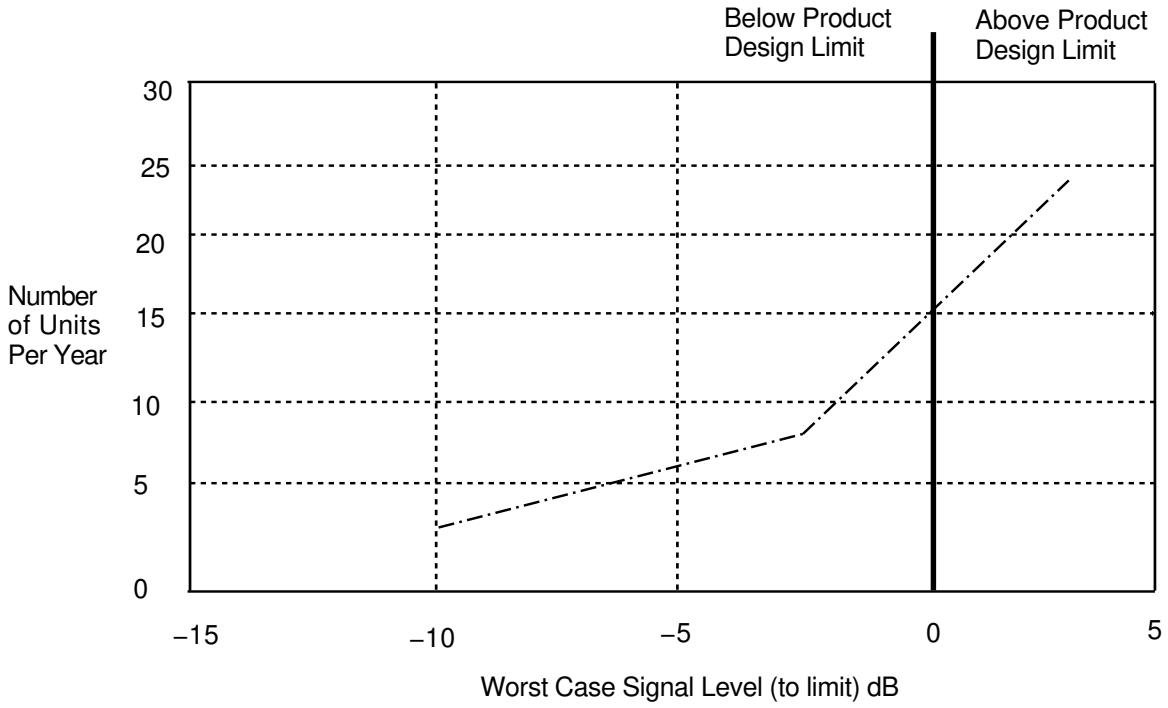
With CFLs Implemented	
Yearly Volume	Sample Rate
$\leq$100 units	None
>100 units	1% or 1 per quarter (whichever is less) Note 1: Minimum 1 per year Note 2: 3 per quarter minimum for first production quarter only
Without CFLs Implemented	
The sample size for a product without an implemented CFL is shown in Figure 1. The sample size is based upon a yearly sample, and is not a percentage of the total volume.	

2.2 CRITICAL FEATURES LIST (CFL)

Creation of a product's CFL is usually the combined responsibility of the product's design engineer(s) and the responsible EMC engineer(s). The CFL must list all components, design features (both electrical and mechanical), and manufacturing processes that are critical to the EMC performance of the product. The best CFL is generated when the design is relatively firm. If there are changes to the product, process, or changes based upon ongoing testing, the existing CFL must be updated to reflect those changes that affect EMC integrity.

The manufacturing facility and the assembly process should be identified as early as possible so the CFL can be reviewed with the responsible manufacturing and quality engineers. This is necessary because the CFL may be written to assist incoming, in-process, and final inspections. Table 2 gives examples of critical features.

Figure 1: Sample Size for Products Without a CFL



Note: If signal levels above the limit are measured, then investigations must take place to determine the cause and the necessary corrective action.

Table 2: Examples of Critical Features

Special components
Finger stock gasket
EMI gasket
Ferrite beads
Filter connectors
and so forth
Subassemblies
Powerline filters
Power supply subassemblies
Shielded wire
Conductive gasketing
Shielded connectors
Revision level of critical parts
Video amplifier board
Asynchronous filter board
Print head driver board
Important tolerances
Gasket gap under compression
Gasket surface flatness
Plating thickness
Important processes
Torque wrench usage
Preparation of gasket surface
Masking of nonpainted areas
Designed features
Addition of signal conditioning components
Addition of shielded compartment
Special ground configuration/point

Component and subassembly inspection may occur as incoming inspection, or it may occur as part of the supplier's final inspection, when Certificates of Compliance are used. When incoming inspection is not used, the critical features of the part must be identified on the purchase specification or drawing, and inspected by the supplier.

The process flow of the entire assembly process must be identified and understood in order to write a document meaningful to the inspection and build processes. The CFL will not apply in the same form at every step of the process. For example, it is not necessary for component inspection to have the same critical features list as the in-process inspection, nor is it necessary for the in-process inspector to re-inspect parts that have passed component inspection.

2.3 CRITICAL FEATURES CONTROL PROCESS

There are two requirements for the CFCP.

1. Keeping the CFL up to date with the product's design and manufacturing processes.
2. Using the CFL to establish all necessary inspections and review processes within manufacturing.

Maintaining the CFL is the combined responsibility of the product's sustaining engineering organization, the responsible manufacturing organization, and the responsible EMC organization. They must ensure that as each engineering change order (ECO), process change order, and field change order (FCO) is reviewed and approved, that necessary changes are incorporated in the CFL. The CFL shall be identified as part of the product's drawing directory.

Use of the CFL is the responsibility of the product's manufacturing organization. Items listed on the CFL must be verified by appropriate inspections. These inspections shall determine whether critical components and subassemblies adhere to design and purchase specification, that fabrication and assembly processes are correctly performed, and that any necessary changes during manufacturing, such as rework, do not impact adherence to the CFL.

APPENDIX A REFERENCED DOCUMENTS

A.1 EL-Class Digital Documents

EL-Class Number	Document Title
EL-00103-00	*DEC STD 103-0 Electromagnetic Compatibility (EMC) - Overview and Process Requirements*

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